



**Is  
Your Home  
Protected**



**From  
Hurricane  
Disaster?**



***A Homeowner's Guide  
to Hurricane Retrofit***

Prepared by the Institute for Business & Home Safety. The Institute for Business & Home Safety (IBHS) is an initiative of the insurance industry to reduce deaths, injuries, property damage, economic losses, and human suffering caused by natural disasters. IBHS is a not-for-profit research and communications organization committed to institutionalizing natural disaster protection as a public value.

## disclaimer

The purpose of this document is to provide homeowners with guidance on ways to retrofit one and two-family homes in order to reduce losses from hurricane winds. It contains suggestions and recommendations based on professional judgment, experience and research and is intended to serve only as a guide. The authors, contributors, and publisher disclaim all warranties and guarantees with respect to the information in the document and assume no liability or responsibility with respect to the information.

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ISBN-1-885312-14-8

 Printed on Recycled Paper.

# acknowledgments

The staff of the Institute for Business & Home Safety (IBHS) wishes to acknowledge the valuable input of all those involved in the preparation of this brochure. In particular, we extend our thanks to:

**W. Lawrence Schwab**

*State Farm Fire and Casualty Company, Bloomington, Illinois*

**Ronald J. Hein**

*CNA Insurance Companies, Chicago, Illinois*

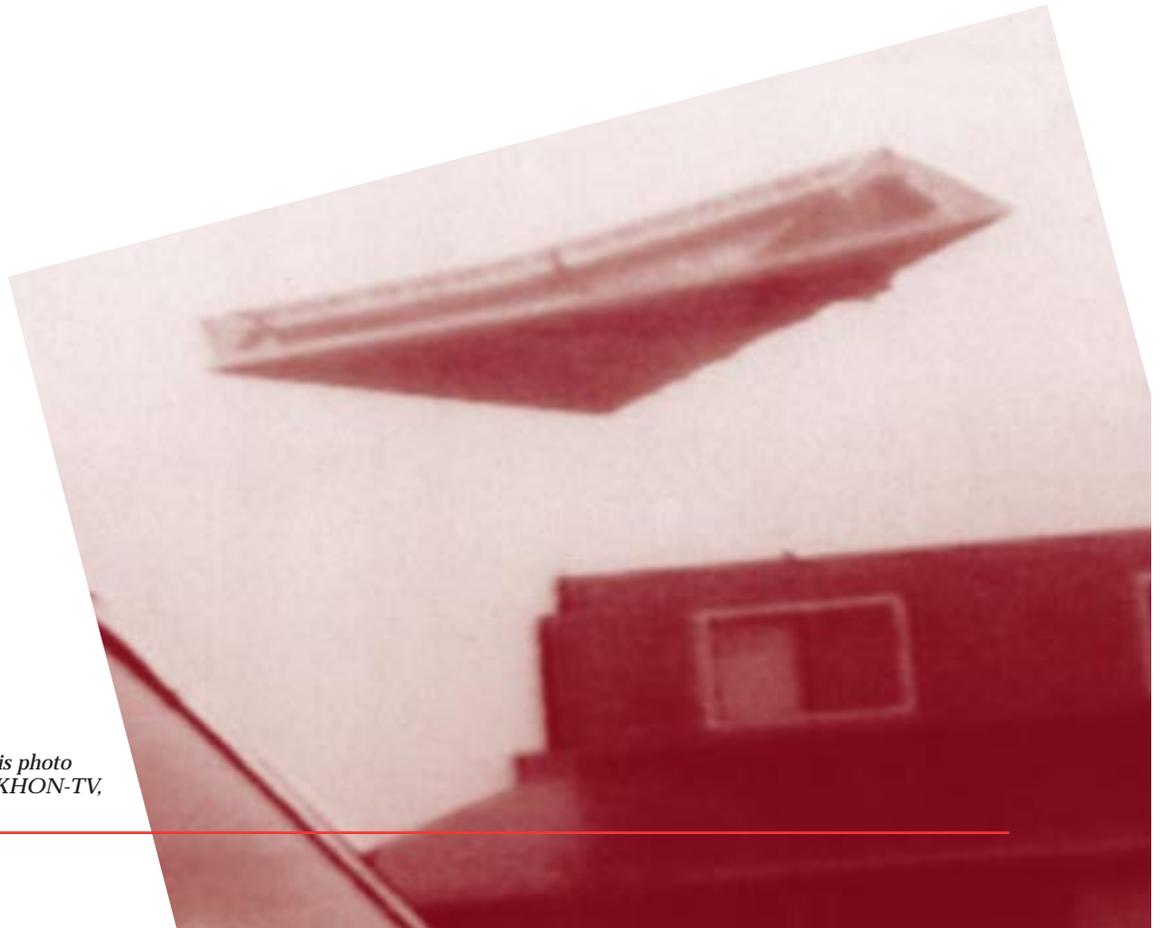
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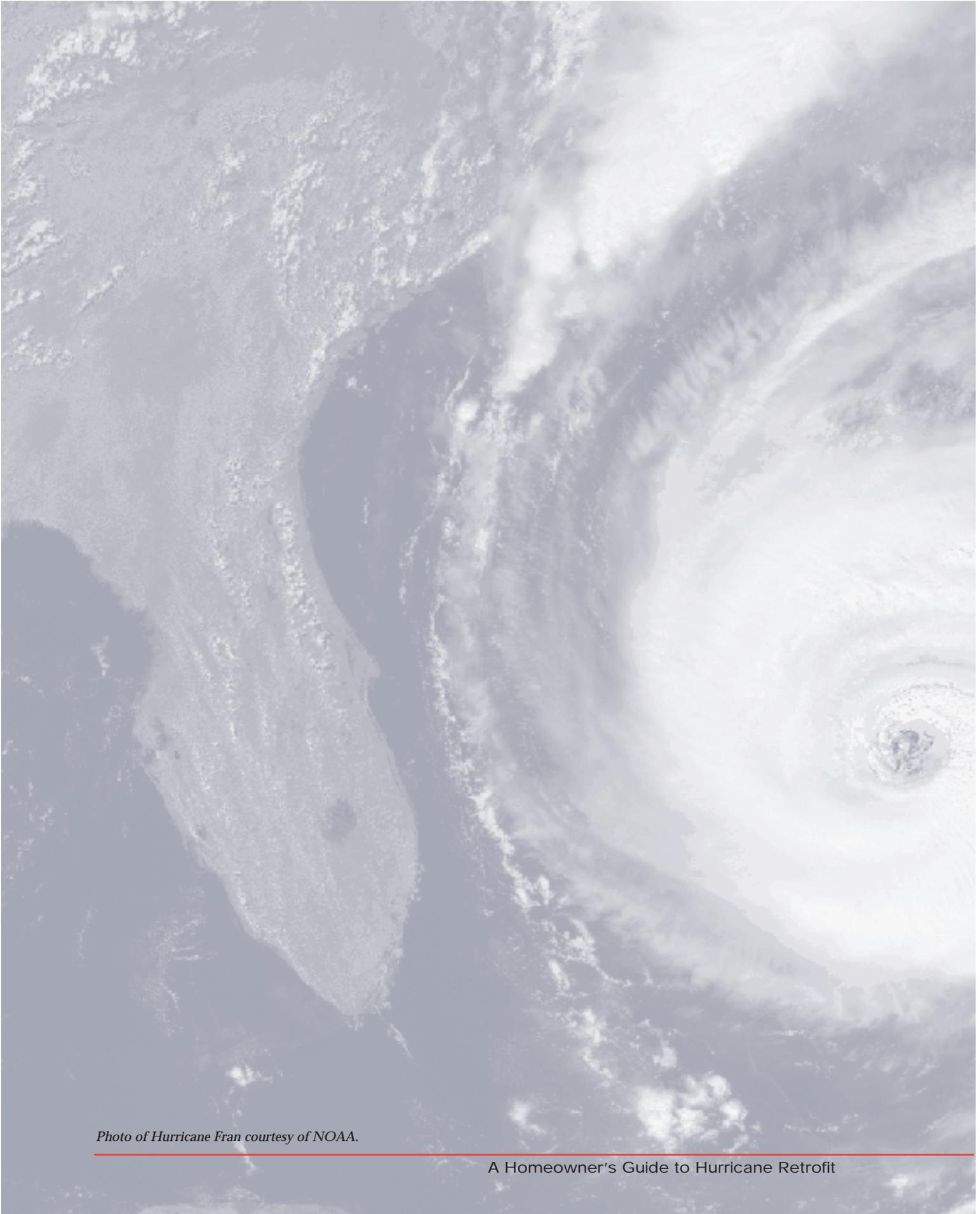
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*Photo from Hurricane Iniki. This photo was reprinted by permission of KHON-TV, channel 2, Honolulu, Hawaii.*



*Photo of Hurricane Fran courtesy of NOAA.*

# table of contents

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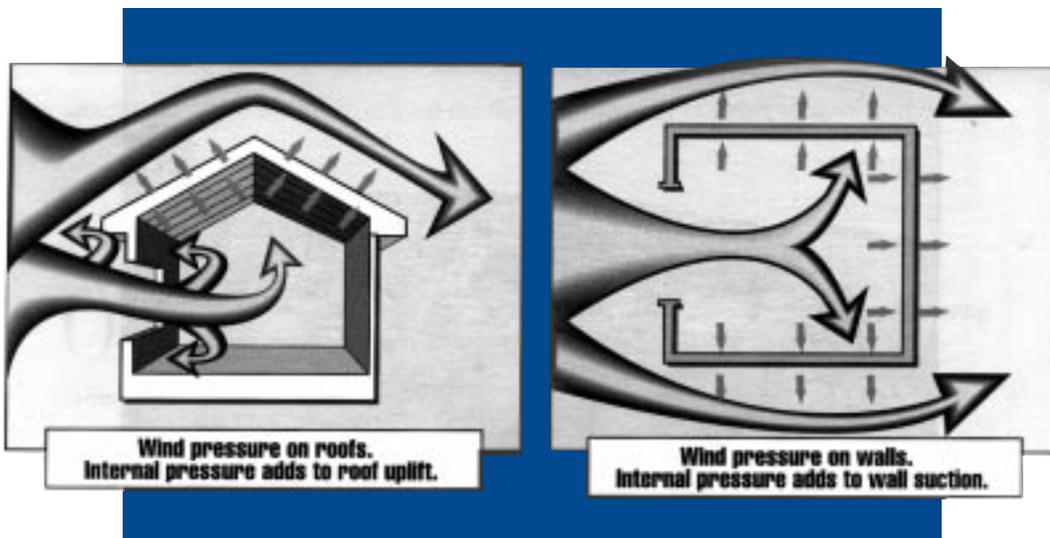
<b>introduction</b> .....	1
Take the Right Precautions .....	2
<b>surrounding environment</b> .....	3
<b>home inspection</b> .....	3
<b>roofs</b> .....	4
Do You Need a New Asphalt Roof? .....	4
Will Retrofitting Your Asphalt Shingle Roof Be Enough? .....	6
Other Roof Covering Products .....	7
Wood Shakes and Shingles .....	7
Clay or Concrete Tile .....	7
Metal Shingles .....	7
Standing Seam Metal Roofs .....	7
<b>roof structure</b> .....	8
Attach Roof Sheathing with Adhesive .....	8
Gable End Walls .....	9
Roof to Top of Wall Connection .....	11
<b>wall openings</b> .....	12
Bracing Your Garage Door .....	12
Doors .....	14
Window and Patio Door Protection .....	15
Window/Patio Door Shutters .....	15
Impact-Resistant Windows/Patio Doors .....	17
Impact-Resistant Standards .....	18
Window Film .....	19
<b>wall to foundation connection</b> .....	20
<b>home improvement project list</b> .....	21
<b>be completely prepared before a disaster strikes</b> .....	23
<b>references</b> .....	24
<b>appendix I: additional sources of information</b> .....	25
<b>appendix II: ibhs member companies</b> .....	28
<b>checklist</b> .....	29



# introduction

**H**urricanes are well known for causing damage to homes and property, for destroying family keepsakes, and for disrupting family life. But, as this brochure explains, you can take action to protect your home. First, though, it helps to learn a little more about the nature of hurricanes. These large, slow moving storms are often accompanied by rain as well as flooding, storm surges, and wind that can come from different directions while circling the eye of the storm. As a result, the wind affects different homes in profoundly different ways, depending on their design, location, and neighboring structures.

Among other things, the wind can collapse windows and doors, rip off roof sheathing (decking) and destroy gable end walls. Overhanging eaves and rakes, extended awnings, open porches, and other features that tend to trap air beneath them are particularly susceptible to damage. Wind-borne debris can break windows and damage roof coverings and walls. With or without the help of wind blown objects, the wind can break through a garage door, window, or door on the windward side of the house and move inside, causing uplift forces to more than double. In fact, these powerful forces, which are illustrated below, can literally lift the roof right off of the house.



Loss of opening protection allows wind entry and increases internal exposure.

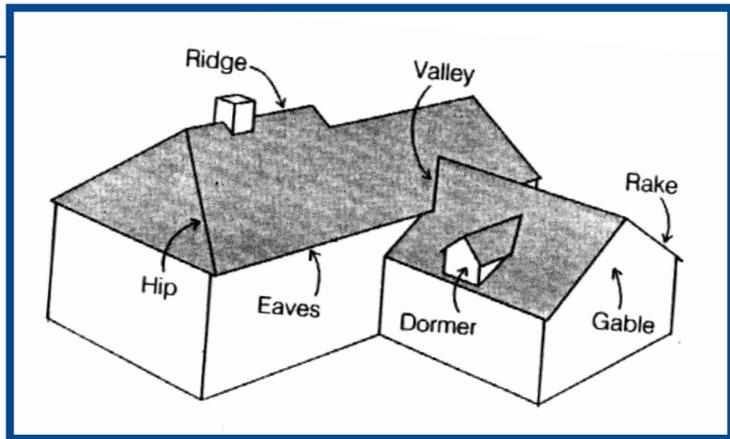
*Drawings courtesy of FEMA.*

## Take the Right Precautions

The most important precaution you can take to reduce damage to your home and property is to protect the areas where wind can enter. According to recent wind technology research, it's important to strengthen the exterior of your house so wind and debris do not tear large openings in it. You can do this by protecting and reinforcing these four critical areas:

- roof
- windows
- doors
- garage doors

A great time to start securing — or retrofitting — your house is when you are making other improvements or adding an addition. In both cases, your local building code will require that your work conform to certain requirements. And, although you may not need to comply with current code requirements on the rest of your house, this may be a good opportunity to do so. Remember: building codes reflect the lessons experts have learned from past catastrophes. Contact your local building code official to find out what requirements are necessary for your home improvement projects.



## Final Note

This brochure contains a check list of home improvement projects. If you do them correctly, you may greatly reduce the chance of hurricane damage. However, nothing can guarantee total protection. Please follow the instructions of your local authorities if told to evacuate, even if you have completed these projects.

Also, remember that these guidelines are broad and you should consult with a registered design professional about specialized items. In addition, while you or a building contractor can perform some of the procedures in this guide, someone with an engineering background should oversee others. For example, only someone with engineering expertise can design a roof sheathing fastening schedule and determine the correct way to connect the roof to the wall.



# surrounding environment

If your house is in an unobstructed location or within 1500 feet of open water, you are more susceptible to damages caused by high winds and should consider this when planning your home improvement project. Also remember that mobile homes, outbuildings, barns, fences, screen enclosures, carports, awnings and canopies can produce wind-borne debris that can tear openings into your house, letting in damaging rain and wind. In addition, objects such as garbage cans, bicycles, lawn furniture, tree limbs, landscaping pebbles and small rocks can become wind-borne, damaging roofs, walls and windows. By properly protecting and maintaining your home and

property, you can minimize potential damage to your neighbors' and your property.

# home inspection

You can inspect your house to see if retrofitting is necessary. If you are uncertain whether your house needs certain changes, or have any questions about your ability to inspect your house, call a qualified professional architect, engineer, building contractor, or your local building department.

Example of failure of the house envelope.



Either you or a building contractor can build and install temporary shutters on windows and coverings for patio and entry doors, strengthen and stiffen garage doors, and install heavy-duty door hardware. However, an experienced installer should install impact resistant doors and windows or approved hurricane shutters in accordance with manufacturer's recommendations. And a roofing professional can best determine when you should replace an aged roof. You will also need a

professional to determine how well a door or window frame is anchored to the exterior walls.

Your local building department can be a good source to get information about retrofitting projects. And remember, although many of the retrofitting projects shown in this brochure do not require building permits, you should contact your local building official to make sure the retrofitting measures you are intending to undertake do not require a building permit. Your local building official can help you with the permit process if you require one.

## roofs

### Do You Need a New Asphalt Roof?

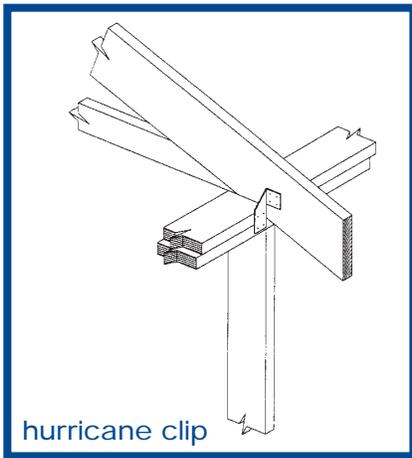
Sooner or later, all roofing needs to be replaced. If a roof covering is old and worn, patching or limited repairs won't help. A roof tends to wear uniformly in most parts of the country, and even the best roofing materials will eventually succumb to weathering. Roofing in extreme wind and heat states like Florida will tend to have shorter life-spans than in other places.

How can you recognize when your roof has problems? Twice a year, do the following:

- On a sunny day, go up to your attic and use a flashlight to inspect for stains caused by leaks.
- Indoors, look for cracked paint, discolored gypsum board, and peeling wallpaper as signs of damaged roof areas.
- Check downspouts for signs of excessive granule loss. Although most shingle manufacturers guarantee their products to last 20 years, many roofs with standard asphalt shingles over 15 years old need reroofing, especially in extreme weather climates.

Example of typical roofing failure. Roof covering, underlayment, and sheathing blown-off. Especially along roof eaves and rakes where wind forces are most severe.





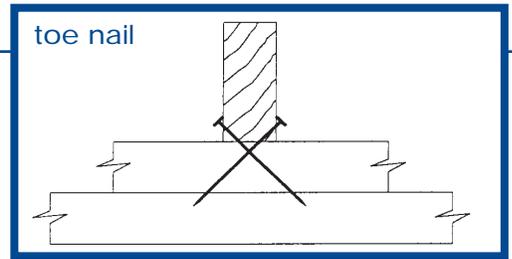
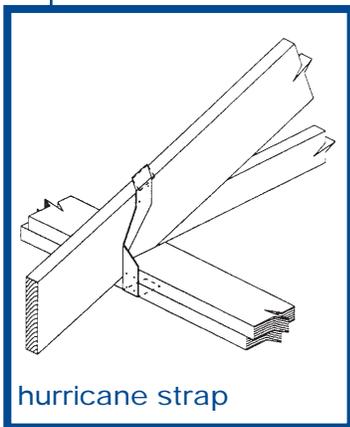
- Use binoculars to inspect the roof from the ground, looking for cracked, curled or missing shingles, excessive loss of protective mineral granules, loose seams or deteriorated flashing, and other visible signs of roof problems.

**BEWARE:** Do not walk on the roof. It is dangerous and may damage the shingles.

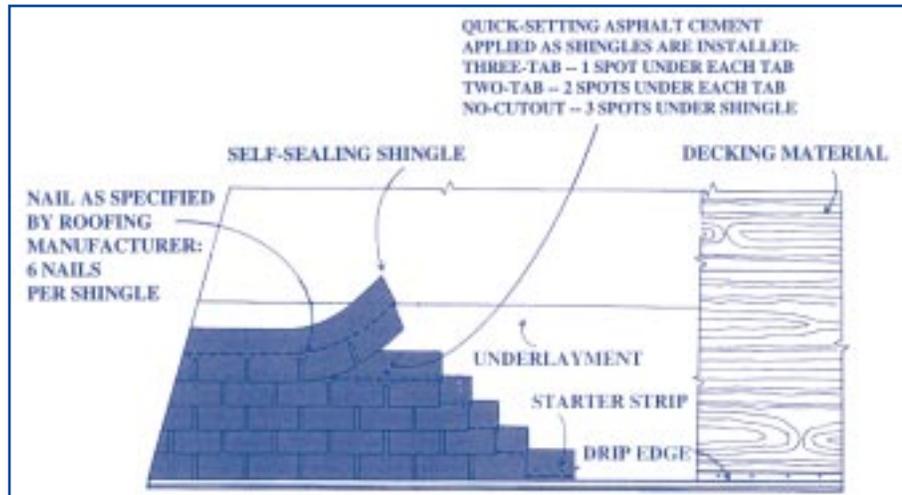
Local ordinances allow homeowners to place asphalt shingles over old shingles. However, for a more secure roof during hurricanes and other high winds, we recommend removing the old shingles before installing the new ones.

If you decide to remove all the old shingles, also remove the underlying building paper to expose the roof sheathing. Inspect the old roof sheathing to determine whether it is rotted, warped, or unsound. If so, replace these sections with sheathing material of the same thickness.

Reroofing is also a great opportunity to inexpensively secure the entire roof. Here's what you do:



1. Remove the bottom row of roof sheathing at the eave lines.
2. Check to see if the roof is fastened to the top of the exterior wall with metal hurricane straps or clips that provide the proper measure of strength and safety. (The common practice of toenailing the trusses or rafters often is not sufficient to hold a roof in place in high winds.) These clips or straps are usually very difficult to see from the attic because of insulation.
3. If not properly fastened, install a hurricane clip/strap where each roof rafter meets the exterior wall.
4. Refasten the roof sheathing removed in step #1, and fasten roof sheathing along the roof corners, ridges, and eaves, where wind pressure has a tendency to grow more intense, by installing additional eight-penny ring shank nails or #8 screws four inches apart. Be careful not to use too many nails or screws, which can split the plywood and weaken your roof. Sheathing which is not located on the edges or ridges of the roof should have eight-penny nails or #8 screws at every six inches.



ARMA's recommended asphalt shingle installation in high wind regions

5. Install roofing felt paper using the double layer application method with tin type fasteners and new shingles with six nails per shingle. For additional strength, secure the tabs of the shingles with quick-setting asphalt cement.

They come with integral locking tabs or factory-applied adhesives that on occasion do not adhere properly to the underlying shingle because of cold weather installation, uneven surfaces or any number of other reasons. For increased wind resistance, have a qualified person inspect several shingle tabs to see if the adhesive has engaged. If not, use a quick-setting asphalt cement to bond them together.

### Will Retrofitting Your Asphalt Shingle Roof Be Enough?

Shingles are usually not designed to resist hurricane force winds.



Photos from Hurricane Iniki. These photos were reprinted by permission of KHON-TV, channel 2, Honolulu, Hawaii.



To cement the shingle tabs to the underlying shingles, place two spots of quick-setting asphalt cement about the size of a quarter under each tab with a putty knife or caulking gun. Press the tab into the adhesive. Be sure to cement all tabs throughout the roof, being careful not to bend them farther than necessary when applying the adhesive. Replace any damaged shingles immediately.

You can get additional information on asphalt roof shingles by contacting the Asphalt Roofing Manufacturers Association.

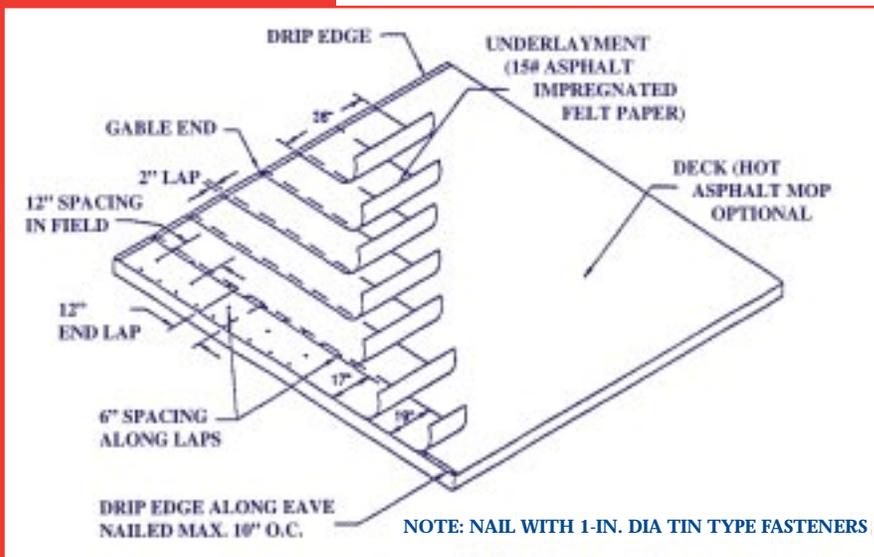
## Other Roof Covering Products

- **Wood Shakes and Shingles**
- **Clay or Concrete Tile**
- **Metal Shingles**
- **Standing Seam Metal Roofs**

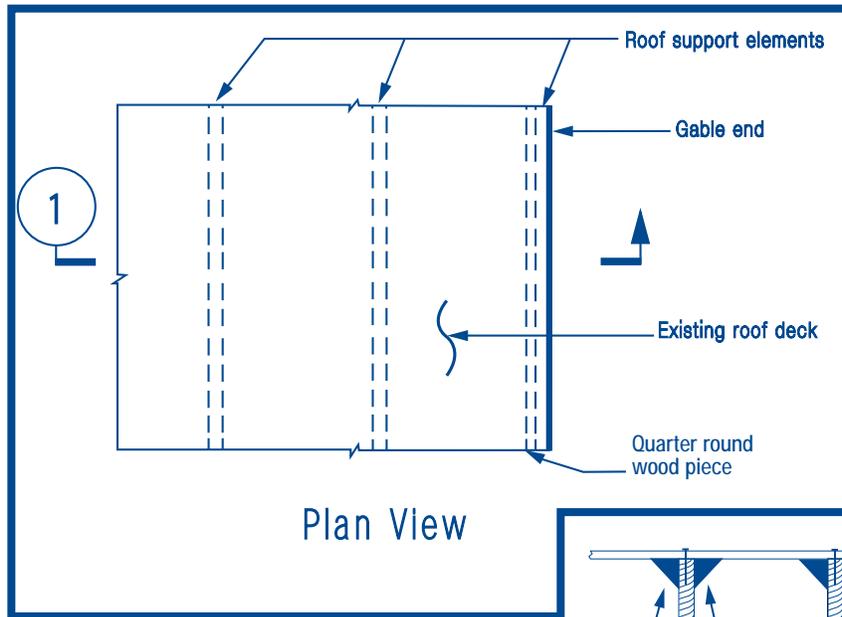
Clay tiles are brittle, and can easily be chipped or broken by wind-borne debris. In fact, the tiles themselves can become wind-borne.

You can have a more secure roof by making sure that all shingles/tiles/panels are fastened down tightly and by replacing the ones that are missing or loose. Hiring a roofing professional to evaluate your roof covering is a good option for the novice homeowner.

double layer  
underlayment  
application



At this time, there are no cost-effective retrofit measures which we can recommend if you have these types of roof coverings. Please contact the roof covering manufacturers listed in the Appendix that are associated with your type of roof for additional information.



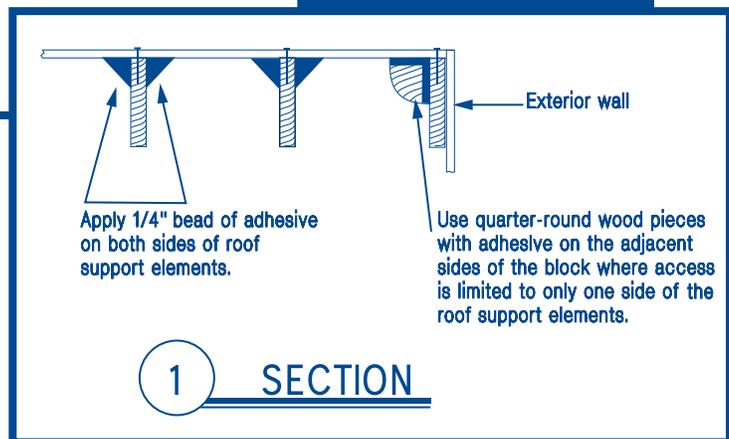
Application of Adhesive to Improve Roof Deck Uplift Resistance

## roof structure

### Attach Roof Sheathing with Adhesive

You can also improve the uplift resistance of the roof deck from the attic — without removing the roof covering. This is how:

- Using a caulking gun, apply a 1/4 - inch bead of wood adhesive along the intersection of the roof deck and the roof support element (rafter or truss chord) on both sides. Make sure that the adhesive is in contact with both the deck and roof support elements.
- At places where you have limited access to either side of the roof support, such as the gable end of the house, use quarter-round



pieces of wood which run the full length of the roof support. Apply the adhesive along the two adjacent sides of the wood block. Press the wood pieces onto the intersection making sure the adhesive is in contact with the deck and roof support elements. The wood pieces can be tack-nailed or clamped in place to ensure good contact between the surfaces.

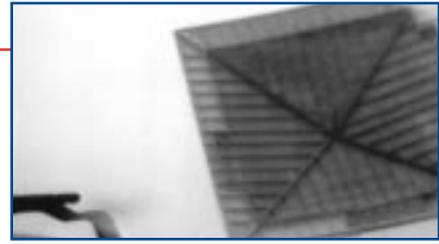
- Attics are typically tight, enclosed areas with poor ventilation. When applying the adhesive, be sure to follow the directions for proper application and ventilation.

According to static pressure tests<sup>1</sup>, using the wood adhesive can increase the wind uplift resistance of the plywood roof sheathing by as much as three times the conventional method of securing the sheathing with nails. A variety of wood adhesives are available at local hardware and building supply stores. In particular, look for products which are certified as AFG-01. Please ask your local hardware expert if other products are available that could provide the same strength and properties as a wood adhesive.

## Gable End Walls

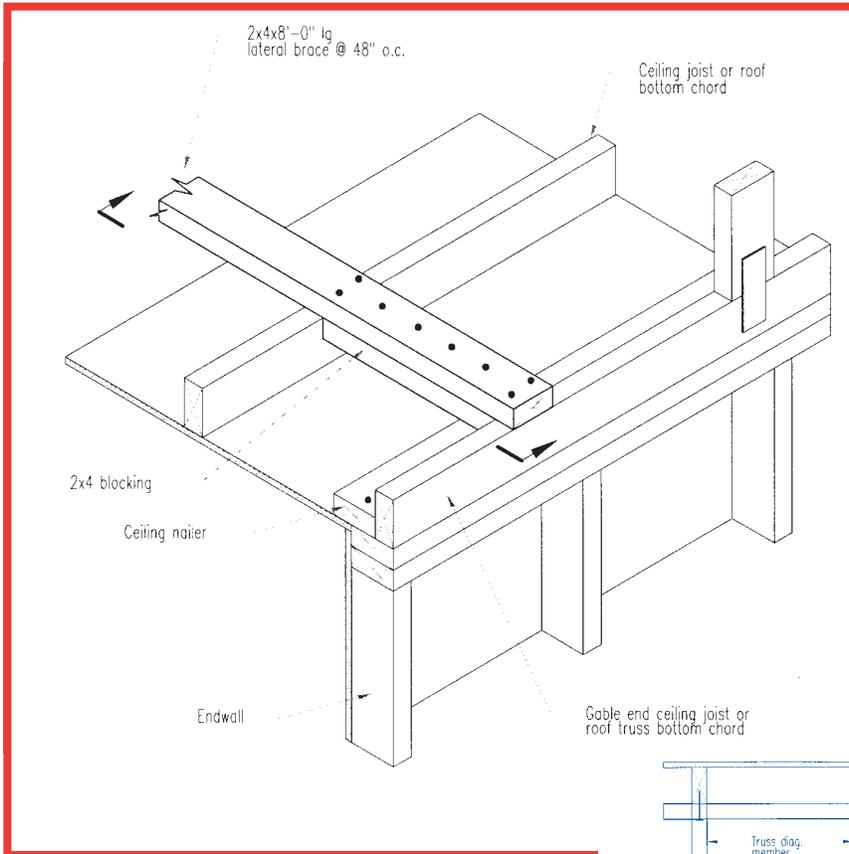
Does your home have a gabled roof? If so, the end wall of your home takes a tremendous beating during a hurricane. If not properly braced, it can collapse, causing significant damage. However, gable end walls are easy to strengthen and deserve to be a high priority on your retrofit list.

Typically, gable end trusses are directly attached to the top of gable end walls. The bottom of the truss must be securely nailed to the top of the wall and braced to adjacent trusses. This prevents wind from pushing or pulling the gable end at its critical point, where the gable truss is connected along the gable wall.



*Photos from Hurricane Iniki. These photos were reprinted by permission of KHON-TV, channel 2, Honolulu, Hawaii.*

<sup>1</sup>Reinhold, Timothy A., "Use of Adhesives to Strengthen the Attachment of Roof Sheathing to Trusses or Rafters for Improved Uplift Resistance in High Winds", a Question and Answer Format Report prepared for The Institute for Business & Home Safety, January, 1998.

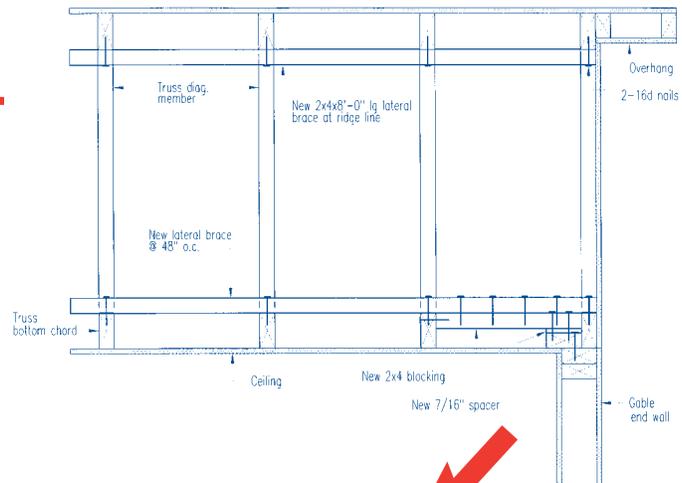


**Strengthen your gable end wall**

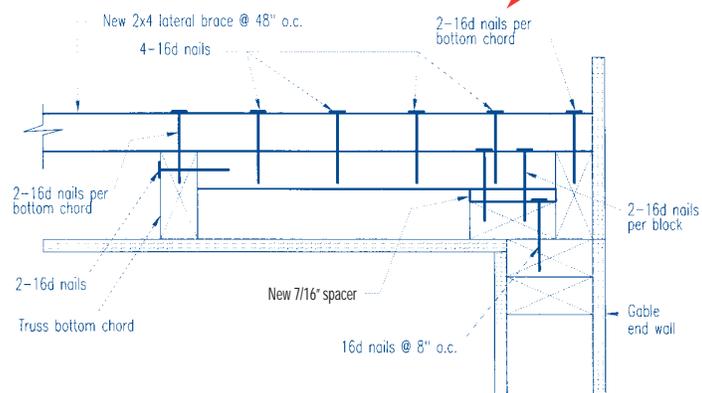
▼ Section View

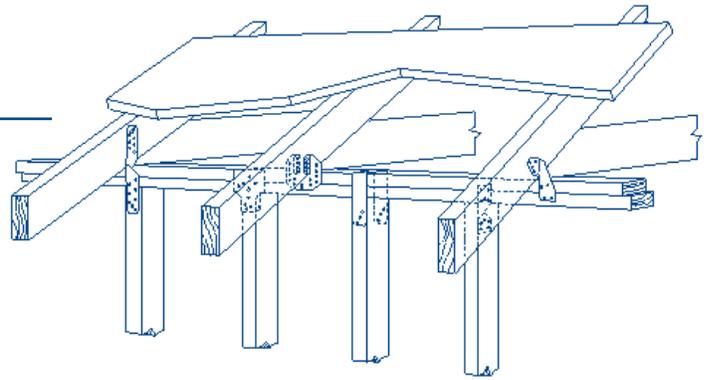
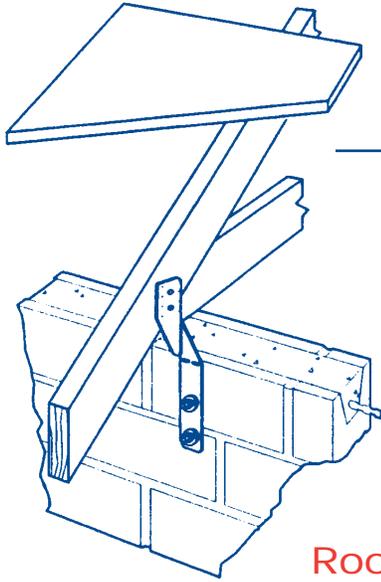
Without adequate bracing, the end wall may be destroyed during hurricane winds.

To secure your gable end wall, fasten eight-foot long braces to the bottom chord of the gable truss and the adjacent trusses with sixteen-penny (16d) nails. The braces should be perpendicular to the truss, spaced at a maximum of four feet on center. In addition, be sure to tie back the gable truss with at least one eight-foot long brace, along the ridge of the roof, to several of the interior trusses as shown in the detail.



**Detail**





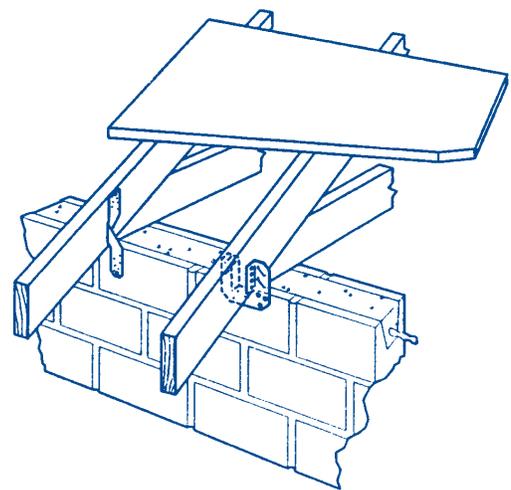
## Roof to Top of Wall Connection

Areas where the roof framing meets the top of stud walls are normally covered by dry wall on the inside and by wall cladding and soffit board on the outside. To install straps or hurricane clips, remove the roof sheathing around the perimeter of the roof to reveal the top of the wall. You may also need to remove the soffit and exterior cladding to reveal the top 12 to 18 inches of the wall. In addition, if the exterior cladding is brick

veneer, you may need to remove small sections of brick as needed.

If your roof has trusses, make sure you tie them to the wall by either anchoring to the top plate and then the top plate to the wall stud, or strapping the truss directly to the wall stud. The figures shown illustrate ways you can anchor the roof to the top of the wall of wood or masonry homes with straps or connectors.

Typical hurricane clips for wood frame and masonry construction.



*Details courtesy of Simpson Strong-Tie.*

# wall openings

## Bracing Your Garage Door

Because of their width, double-wide garage doors are more susceptible to wind damage than single doors. Unless you have a tested hurricane resistant door, the wind may force it out of the roller track — especially if the track is light weight or some of the anchor bolts are not in place. This occurs because the door deflects too much under excessive wind pressure and fails.

To secure your garage door:

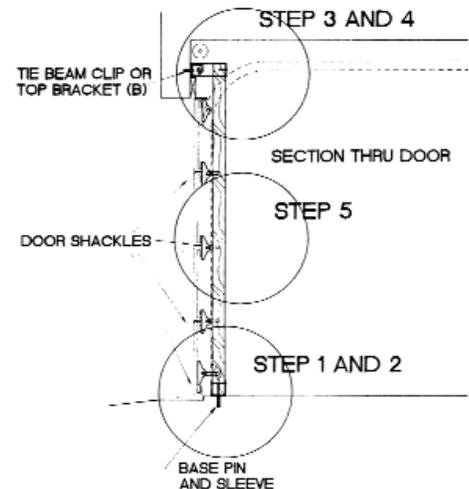
- Check with your local government building official to see if there are code requirements for garage doors in your area.
- Check with your local building supplier or garage door retailer to see if a retrofit kit is available for your garage door.

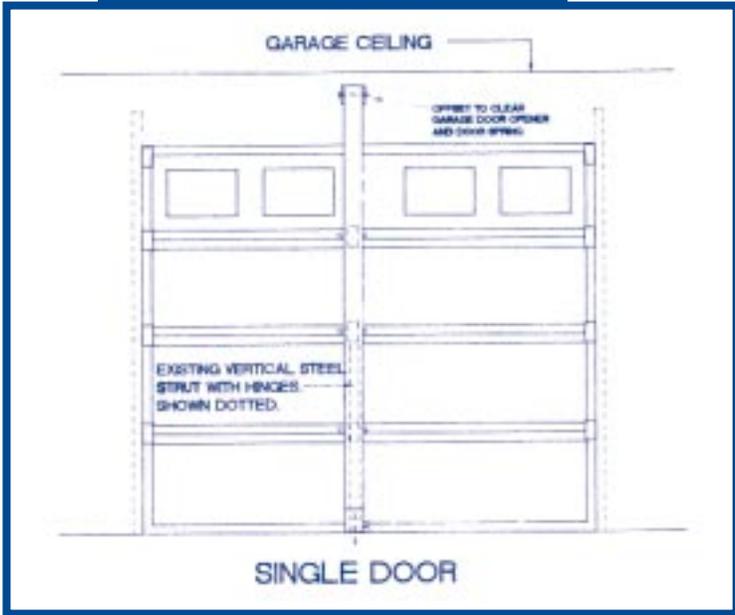
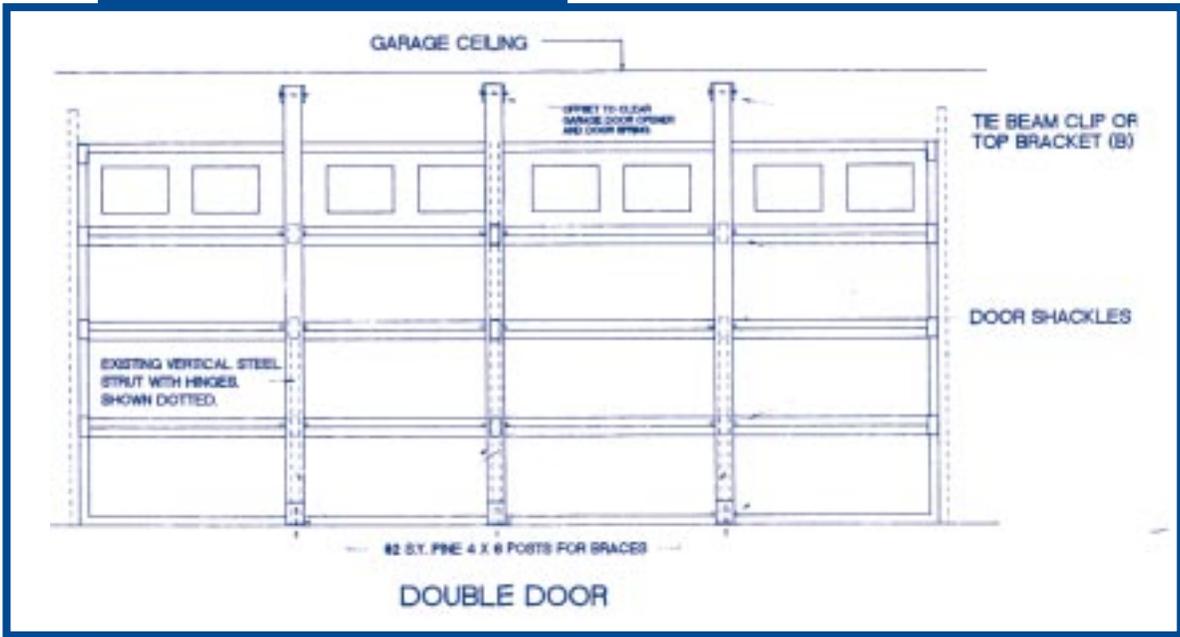


You should probably reinforce your double-wide garage door at their weakest points. This involves installing horizontal and/or vertical bracing onto each panel, using wood or light gauge metal girts bolted to the door millions. You may also need heavier hinges and stronger end and vertical center supports for your door.

If you decide to retrofit your garage door with a kit that allows you to operate the door after it is installed, make sure the door is balanced by lowering it about halfway and letting go. If the door goes up or down, the springs will need adjusting. *Note: Since the springs are dangerous, only a professional should adjust them.*

Gable End Wall and Garage Door Failure. Examples of inadequate bracing to provide proper load transfer.



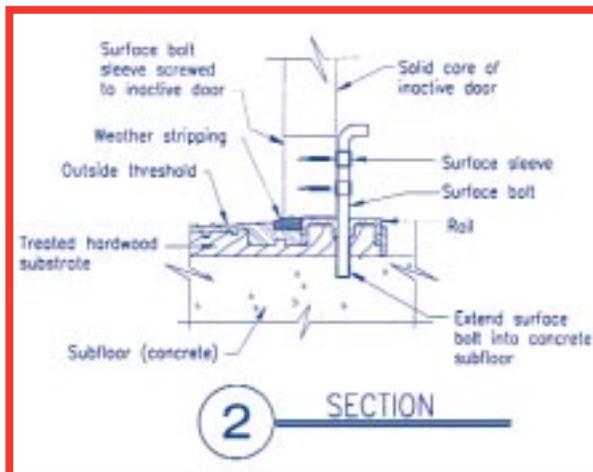
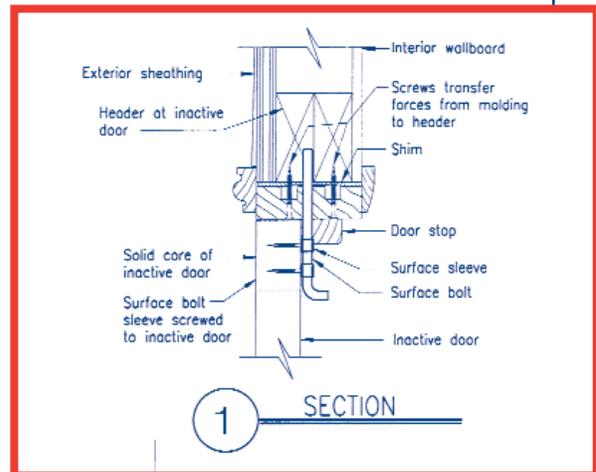
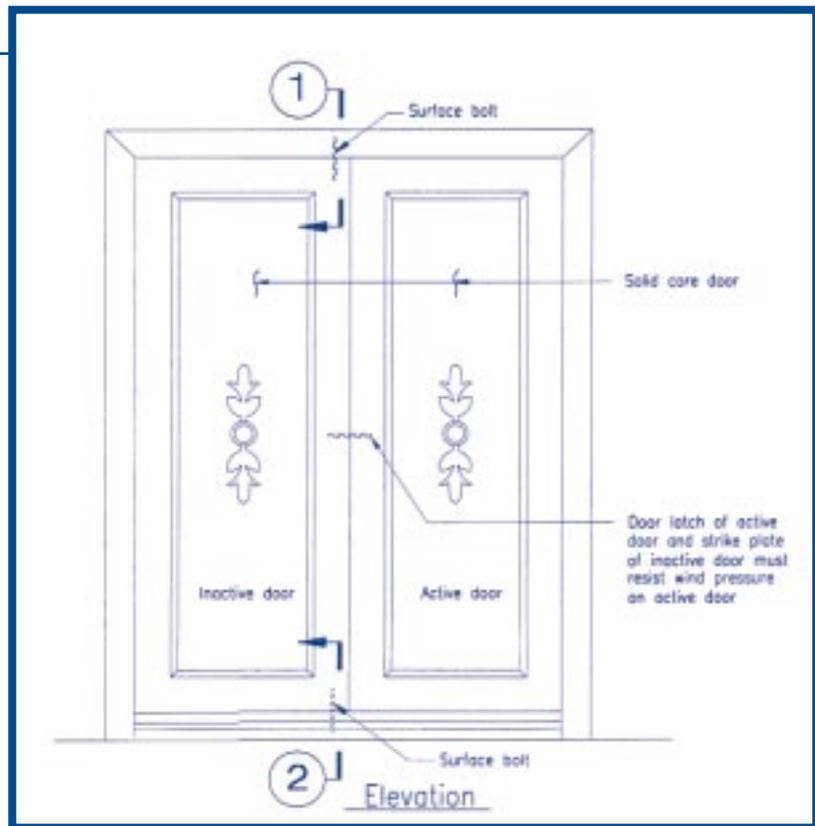


If you are unable to retrofit your garage door with a kit specifically designed for your door, you can purchase garage door retrofit kits to withstand hurricane winds at your local building supply store. Also, check to see if the supplier can do the installation.

## Doors

Your home has either double or single entry doors. If they are solid wood or hollow metal they probably can resist wind pressures and hurricane debris. However, if you are not sure whether they are strong enough, take these precautions:

- Install head and foot bolts on the inactive door of double entry doors.
- Make sure your doors have at least three hinges and a dead bolt security lock which has a minimum one inch bolt throw length.
- Since double entry doors fail when their surface bolts break at the header trim or threshold, check the connections at both places. Be sure the surface bolt extends into the door header and through the threshold into the subfloor.





## Windows and Patio Door Protection

*In the following section, we present several viable ways to protect your windows and doors against damage during a hurricane. We are often asked whether masking tape or any other type of tape placed across the glass will provide protection against storm debris — the unequivocal answer is NO. Hurricanes are devastating forces of nature and more substantial protection is required to withstand their wrath.*

- **Window/Patio Door Shutters**

One way to protect a home from damage in windstorms is to install impact-resistant shutters over all large windows and glass doors. Not only do they protect doors and windows from wind-borne objects, but they can reduce damage caused by sudden pressure changes when a window or door is broken.



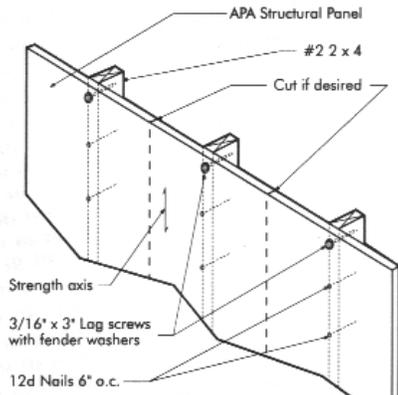
The easiest designs are those that simply cover the opening with a structural panel such as plywood. **In past hurricanes, many homeowners, upon returning, have noticed their temporary plywood shutters blew off because they were not adequately fastened.** If you have a wood-frame house, use adequate fasteners to attach the panels over the openings when a hurricane approaches. Have these temporary shutters stored and ready to use since building supply stores generally sell out of these materials quickly during a hurricane warning. If your home is made with concrete blocks, however, you will have to install anchoring devices well in advance.

The APA - *The Engineered Wood Association* offers a series of Hurricane Shutter Designs. They include:

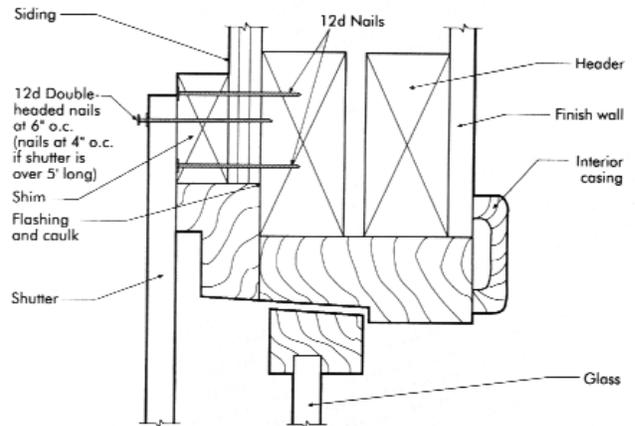
- **DESIGN 1:**  
Shutters for Wood-Frame Buildings
- **DESIGN 2:**  
Shutters for Masonry Block Structures, *Barrel Bolt Latch Supports*
- **DESIGN 3:**  
Shutters for Masonry Block Structures, *Steel or Aluminum Angle and Screw Supports*

# Plywood Hurricane Shutter Design 1

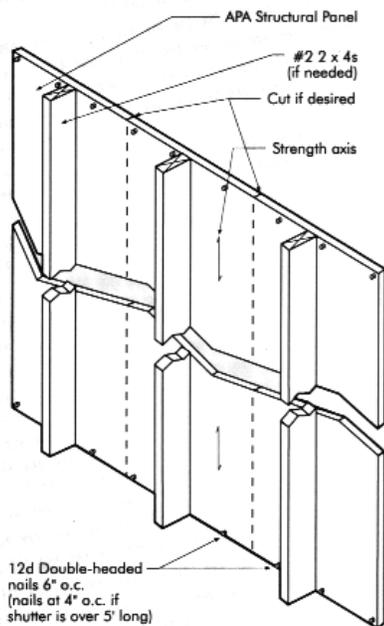
## SHUTTER STIFFENER ATTACHMENT – IF REQUIRED



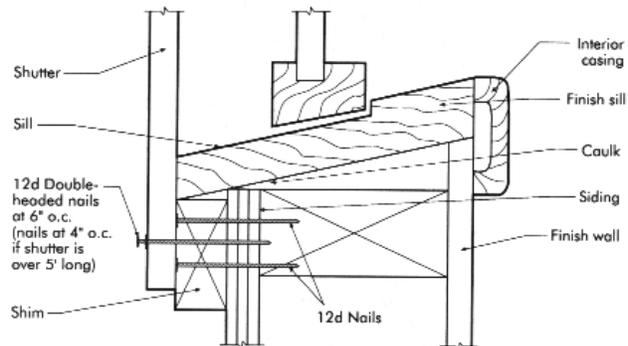
## SHUTTER ATTACHMENT – TOP



## SHUTTER ATTACHMENT – VIEW FROM OUTSIDE



## SHUTTER ATTACHMENT – BOTTOM



- **DESIGN 4:**  
Shutters for Masonry Block Structures, *Shutters Attached to Outside Wall with Permanently Mounted Brackets*
- **DESIGN 5:**  
Shutters for Masonry Block Structures, *For Openings Wider than 8 Feet*

The detail illustrations show how you can install shutters into a wood-frame home (APA Design 1).

Each design is available from APA - *The Engineered Wood Association*.

If your residence has permanent shutters, evaluate their effectiveness. Manufacturers are responsible for testing their shutters up to the standards necessary to resist wind forces and wind-borne debris. Some shutters are very flexible, especially those that roll up.

If struck by a rigid piece of debris, shutters may bend and break the window. To determine whether your shutter can resist this impact, gently lean against it and see if it yields. You can also inspect your shutters to see if they are properly attached to the house and will not fly off during a storm by inspecting the shutter connectors for obvious excessive wear or missing connectors. Ask the shutter manufacturer for proper installation criteria.

- **Impact-Resistant Windows/  
Patio Doors**

Another way to protect your home from damage in windstorms is through the installation of impact-resistant windows and doors. Although these products look no different than standard windows and doors, they offer significantly more protection from wind-borne debris. In fact, these systems are capable of resisting impacts from large objects. For this reason, temporary shutters do not need to be installed before a storm strikes.

In general, the frame and glazing work together to protect your home from both the elements and the significant internal pressure changes which lead to structural damage. While large wind-borne debris may crack the impact resistant glass during the course of the storm, the window is designed to retain its integrity and not break apart. Should either the frame or glass be damaged, it can be repaired at your convenience after the storm has passed.

Consider installing impact-resistant windows and doors when your existing windows and doors require replacement or when you are planning new construction.

You can purchase certified windows and doors through qualified manufacturers at local building supply stores. There are a variety of different systems; however, the best impact-resistant windows and doors typically consist of either laminated glass, plastic glazing, or combination plastic and glass systems. Be sure that the installation guidelines are followed carefully.

- **Impact-Resistant Standards**

Currently, several different organizations have missile impact test standards. Permanent and temporary shutters, in addition to impact-resistant window and door systems, should meet one or all of these standards:

- **SSTD-12**  
Southern Building Code  
Congress International Test  
Standard for Determining  
Impact Resistance From  
Wind-borne Debris
- **Impact Test Procedures for  
Metropolitan Dade County  
Building Code Compliance  
Office:**
  - **PA-201-94:** Impact Test  
Procedures

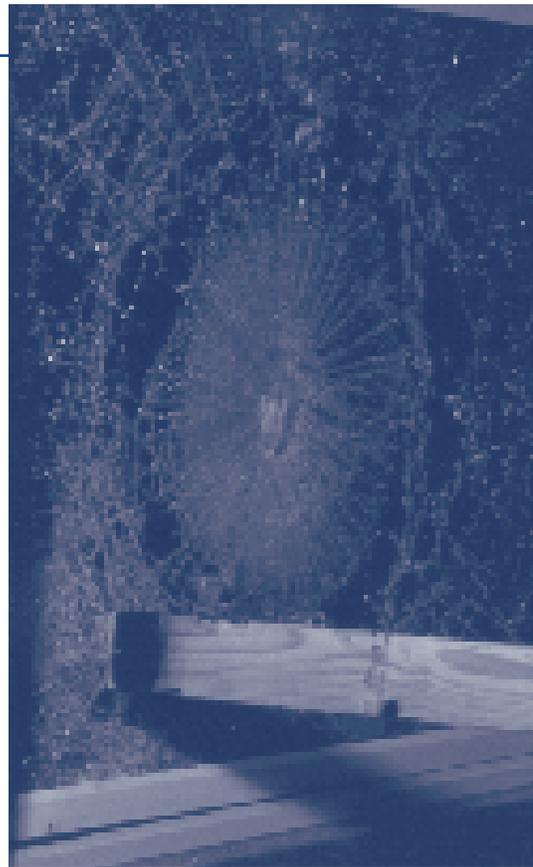


Photo Courtesy of Solutia®

Impact-Resistant  
Window After  
Direct Blow  
From Debris

- **PA-202-94:** Criteria for  
Testing Impact and Non-  
Impact-Resistant Building  
Envelope Components Using  
Uniform Static Air Pressure
- **PA-203-94:** Criteria for  
Testing Products Subject to  
Cyclic Wind Pressure Loading
- **ASTM E 1886:**  
Standard Test Method  
for Performance of Exterior  
Windows, Curtain Walls,  
Doors and Storm Shutters  
Impacted by Wind-borne  
Debris in Hurricanes.

- **Window Film**

Some homeowners have considered window film as an alternative to other window protection systems. The most common method of installing window film is known as “daylight installation.” The process involves pre-cutting the adhesive-backed film to a size slightly larger than the windowpane to which it will be applied. Then, at the time of installation, the film is trimmed back to the size of the windowpane.

One of the most common types of window film is known as “safety film.” This type of film should never be less than 4 mils in thickness. Typically, safety film products meet the same break-safe

requirements as tempered safety glass. This means that the safety film should hold the glass shards together, thus preventing a potential hazard from sharp, broken glass. Safety film may also offer a degree of protection in the case of high winds, but should not be considered adequate protection for windows in hurricane-prone areas.

As a homeowner in a hurricane-prone area, you should always purchase a product or system which has been tested and certified as passing one of the previously mentioned impact-resistant standards. To date, no daylight installed window film, regardless of its thickness, has passed any impact-resistant standard.

Normal  
Window After  
Hurricane

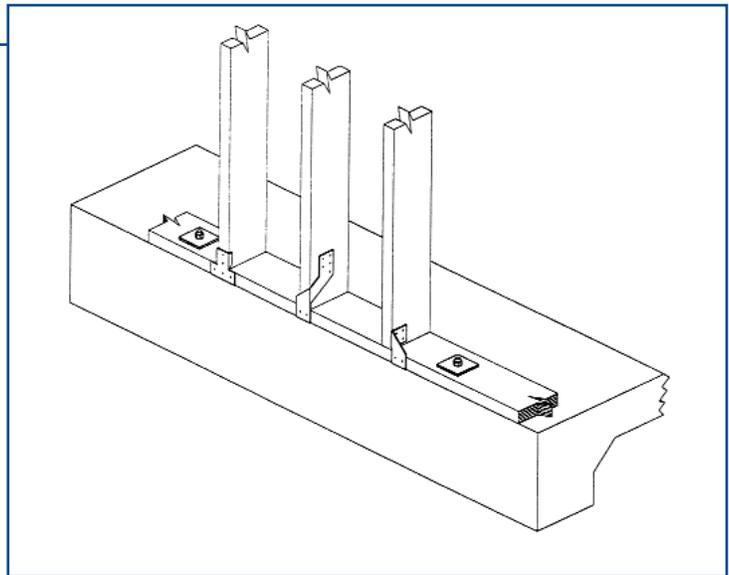


Photo Courtesy of P. Beers

# wall to foundation connection

To complete your home strengthening process, make sure the exterior walls are anchored to the foundation. Although this is not as critical as some of the other tasks on your list, an inadequate connection between the wall and foundation could weaken your entire home. This is especially true if you live in a one-story home with large roof truss spans and a low-sloped roof.

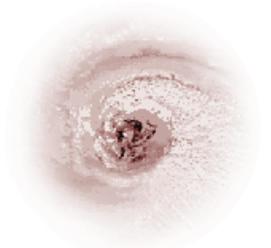
Make sure the wall studs are adequately connected to the sill plate, which sits directly on top of the foundation wall. Metal clips are available at your building supply store for this task. Then drill holes through the existing sill plate into the concrete foundation to install the anchor bolts. Place the holes as close to the center of the sill plate as possible using epoxy anchors which you can find at your local



building supply store.

An engineer should determine the minimum bolt spacing for the force analysis of the shear and uplift loads. But placing 5/8-inch diameter anchor bolts no more than six feet apart, with an anchor bolt at the end of each wall, provides an extra measure of safety for your home. Unfortunately, if you have a concrete masonry block home, verifying that the exterior wall is connected to the foundation is extremely difficult. In that case, the best method to make sure that all required reinforcing is present and installed correctly is to inspect for it while the home is being built.

Detail of proper wall stud to sill plate to foundation connections.



# home improvement project list

This list of home improvements is divided into cost categories. You can tackle these projects one at a time, but remember, the more you do, the stronger your home will be against hurricane winds.

## Category \$ (<\$300)

- Gather outdoor furniture, garbage cans, potential debris, etc., and move them inside. Encourage your neighbors to do the same.
- Replace gravel/rock landscaping material with shredded bark.
- Keep trees and shrubbery trimmed. Cut weak branches and trees that could fall or bump against the house. When trimming, try to create a channel through the foliage to the center of the tree to allow for air flow. Keep climbing roses and vines trimmed back.
- Screened porches and other similar areas are usually first to suffer damage, so make sure the porch is properly attached. (The industry has no standards yet for adequate performance of porch screens in hurricane winds).
- Reinforce the double-entry doors with heavy duty foot and head bolts, and use a security dead bolt lock with one inch minimum bolt throw length.
- Reinforce the double garage door and tracks.
- If you find that the roof sheathing is not adequately attached:
  - use adhesive to attach the sheathing to the rafters
  - use extra 8d (8 penny) nails or #8 screws if you need to reroof
- Brace the gable end walls and roof trusses.

## Category \$\$ (\$300 - \$1000)

- Cover all large windows and patio doors with securely fastened storm shutters made from plywood.
- Replace double garage door with hurricane wind load tested garage door.

## Category \$\$\$ (>\$1000)

- Install hurricane clips/straps connecting roof rafters/trusses to the side walls.
- Install tested/manufactured hurricane shutters.
- Check to see if the exterior walls are connected to the foundation properly if you have a wood-frame house. If your house has masonry type construction, you will need professional assistance which will increase the costs considerably.
- Replace roof covering and during reroofing:
  1. Strip off the old roof coverings to expose existing sheathing.
  2. Inspect existing sheathing to make sure it is properly attached and refasten as necessary.
  3. Remove bottom row of sheathing to inspect wall-roof framing connection and install hurricane clips/straps as necessary (adds only a slight extra cost to a reroofing project).
  4. Replace the sheathing.
  5. Apply a double layer of felt paper underlayment or a single layer of adhesive backed rubberized asphalt sheet waterproofing underlayment.
  6. Install roof covering shingles that are rated for hurricane-force winds based on the manufacturer's recommendations. Apply additional adhesives as needed.

# be completely prepared before a disaster strikes

Implementing the techniques recommended in this brochure gives you and your family a better chance of surviving a natural disaster. But these steps are only the beginning. To protect yourself as fully as possible you should also:

- Become familiar with your community's disaster preparedness plans and create a family plan. Plan an escape route from your home and neighborhood and designate an emergency meeting place for the family to reunite if you leave in separate vehicles. Also establish a contact point to communicate with concerned relatives.
- Periodically review your homeowners insurance policy with your insurance agent or company to make sure you have sufficient coverage to enable you to rebuild your home and life. Remember, your homeowners insurance policy does not cover damage caused by floods. Flood insurance is provided by the federal government through the National Flood Insurance Program. If you are in a flood-prone area, you should purchase flood insurance. Contact your agent or company representative, or call 1-800-427-4661.
- Put together an emergency kit that includes a three-day supply of drinking water and food requiring no refrigeration and, generally, no cooking; first aid supplies; a portable NOAA weather radio; a flashlight; emergency cooking equipment; portable lanterns and batteries.
- If a weather-related disaster threatens, follow weather and news reports so you know how much danger you're facing. And obey evacuation orders from local authorities. No material possession is worth risking your health, let alone your life.

# references

American Plywood Association.  
**Hurricane Andrew: Structural Performance of Buildings in Southern Florida.** Report T92-21. Tacoma, WA: APA, 1992.

American Plywood Association.  
**Hurricane Shutter Designs.** Form Nos. T451B, T452B, T453B, and T455B. Tacoma, WA: APA, 1995.

American Red Cross, et. al.  
**Against the Wind: Protecting Your Home From Hurricane Wind Damage.** Washington, DC: American Red Cross; Federal Emergency Management Agency, 1993.

Asphalt Roof Manufacturing Association. **Residential Asphalt Roofing Manual.** ARMA Form No. 421-RR-84. Rockville, MD: ARMA, 1993.

Federal Emergency Management Agency. **Hurricane Andrew: Building Performance Assessment: Observations, Conclusions, and Recommendations.** Washington, DC: FEMA, 1993.

Haag Engineering Company.  
**Hurricane Andrew Survey Damage Assessment Code Compliance.** Carrollton, TX: Haag Engineering, 1992.

McDonald, J.R. and Yu Feng.  
**Hurricane Retrofit Guidelines for One and Two Family Homes.** DRAFT Report for the Insurance Institute for Property Loss Reduction. Lubbock, TX: Texas Tech University, 1997.

Southern Building Code Congress International, Inc. **Standard for Hurricane Resistant Residential Construction SSTD 10-97.** Birmingham, AL: SBCCI, 1996.

The Weather Channel and Home Depot. **Hurricane.** Atlanta: The Weather Channel; Home Depot.



*Photo from Hurricane Iniki. This photo was reprinted by permission of KHON-TV, channel 2, Honolulu, Hawaii.*

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# appendix I: additional sources of information

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## APA - The Engineered Wood Association (APA)

P.O. Box 11700  
Tacoma, WA 98411-0700  
Tel: 253-565-6600  
Fax: 253-565-7265  
<http://www.apawood.org/>

## American Society of Civil Engineers (ASCE)

1801 Alexander Bell Drive  
Reston, VA 20191-4400  
Tel: 703-295-6300  
Fax: 703-295-6333  
<http://www.asce.org/>

## American Society of Home Inspectors (ASHI)

932 Lee Street, Suite 101  
Des Plaines, IL 60016  
Tel: 800-743-2744  
<http://www.ashi.com/>  
Fax: 847-759-1620

## Asphalt Roofing Manufacturers Association (ARMA)

6000 Executive Blvd., Suite 201  
Rockville, MD 20852  
Tel: 301-231-9050  
Fax: 301-881-6572

## Building Officials & Code Administrators International, Inc. (BOCA)

4051 West Flossmoor Road  
Country Club Hills, IL  
60478-5795  
Tel: 708-799-2300  
Fax: 708-799-4981  
<http://www.bocai.org/>

## Cedar Shake & Shingle Bureau (CSSB)

P.O. Box 1178  
Sumas, WA 98004  
Tel: 604-462-8961  
Fax: 604-462-9386  
<http://www.cedarbureau.org>

## Door & Access Systems Manufacturers Associations International (DASMA)

1300 Sumner Avenue  
Cleveland, OH 44115-2851  
Tel: 216-241-7333  
Fax: 216-241-0105

**Federal Emergency  
Management Agency  
(FEMA)**

500 C Street, SW  
Washington, DC 20472  
Tel: 202-646-3923  
Fax: 202-646-3930  
<http://www.fema.gov/>

**Institute for Business &  
Home Safety (IBHS)**

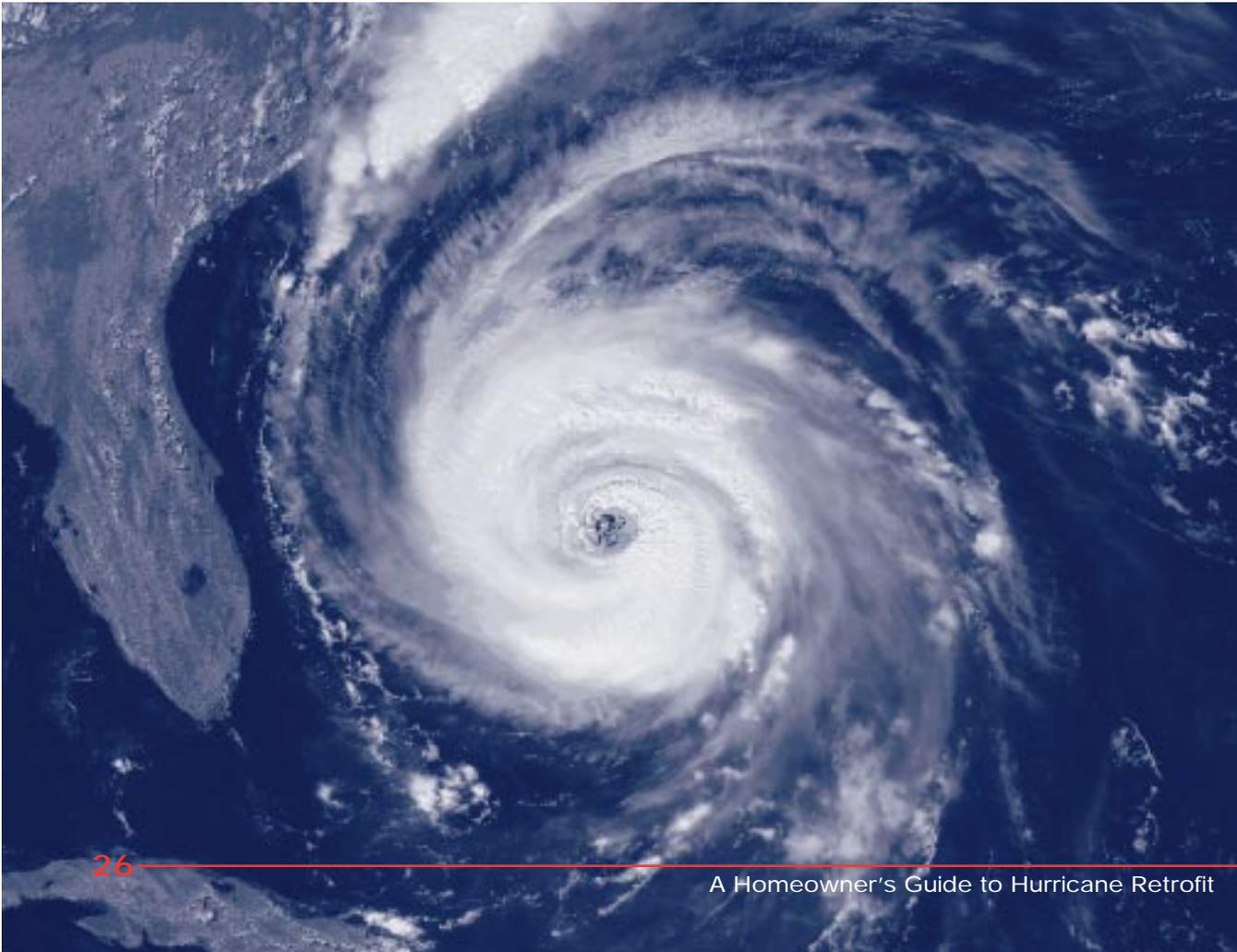
175 Federal Street, Suite 500  
Boston, MA 02110-2222  
Tel: 617-292-2003  
Fax: 617-292-2022  
<http://www.ibhs.org/>

**International Code Council  
(ICC)**

5203 Leesburg Pike, Suite 708  
Falls Church, VA  
Tel: 703-931-4533  
Fax: 703-379-1546  
<http://www.intlcode.org/>

**International Conference of  
Building Officials (ICBO)**

5360 South Workman Mill Road  
Whittier, CA 90601-2298  
Tel: 310-699-0541  
Fax: 310-692-3853  
<http://www.icbo.org/>



### International Window Film Association

318-A Brown Street  
P.O. Box 3871  
Martinsville, VA 24115-3871  
Tel: 540-666-4932  
Fax: 540-666-4933  
<http://www.iwfa.com>

### Metal Roofing Systems Association

1300 Summer Ave.  
Cleveland, OH 44115-2851  
Tel: 216-241-7333  
Fax: 216-241-0105  
[http://www.mbma.com/  
welcome.htm](http://www.mbma.com/welcome.htm)

### Metropolitan Dade County

Building Code Compliance Office  
140 W. Flagler Street, Suite 1603  
Miami, FL 33130  
Tel: 305-375-2901  
Fax: 305-375-2908  
<http://www.buildingcodeonline.com>

### National Association of Home Builders (NAHB)

1201 15th Street, N.W.  
Washington, D.C. 20005  
Tel: 202-822-0200  
Fax: 703-243-3465  
<http://www.nahb.com/>

### National Association of the Remodeling Industry

4900 Seminary Rd., Suite 320  
Alexandria, VA 22311  
Tel: 703-276-7600  
Fax: 703-243-3465  
<http://www.nari.org/>

### National Roofing Contractors Association (NRCA)

10255 West Higgins Road,  
Suite 600  
Rosemont, IL 60018-5607  
Tel: 847-299-9070  
Fax: 847-299-1183  
<http://www.roofonline.org/>

### National Tile Roofing Manufacturers Association (NTRMA)

P.O. Box 40337  
Eugene, OR 974404-0049  
Tel: 503-689-0366  
Fax: 503-689-5530

### Southern Building Code Congress International, Inc. (SBCCI)

900 Montclair Road  
Birmingham, AL 35213-1206  
Tel: 205-591-1853  
Fax: 205-592-7001  
<http://www.sbcci.org/>

# appendix II: ibhs member companies

Alfa Insurance Group  
Allendale Group  
Alliance Insurance Companies  
Allstate Insurance Group  
American Agricultural Insurance Company  
American Family Insurance Group  
American Re Corporation Group  
American States Insurance Company  
Amica Mutual Insurance Company  
Andover Group  
Automobile Club Insurance Association  
Baldwin Mutual Insurance Company  
Bankers Insurance Group  
Barnstable Group  
Bituminous Casualty Corporation  
Brethren Mutual Insurance Company  
Chartwell Reinsurance Company  
CIGNA Group  
Cincinnati Financial Corporation  
CNA Insurance Group  
Colonial Penn Group  
Country Companies  
EMC Insurance Companies  
Employers Insurance of Wausau —  
A Mutual Company  
Employers Re Group  
Farm Bureau Group of Iowa  
Farmers Insurance Group  
FCCI Insurance Group  
First Floridian Auto and Home  
Insurance Company  
Florida Farm Bureau Casualty  
Insurance Company  
Foremost Corporation Group  
General Re Group  
Gerling Global Reinsurance Corporation  
of America  
Germania Mutual Group  
Grange Mutual Insurance Company  
Harleysville Insurance Companies  
The Hartford Insurance Group  
The Hartford Steam Boiler Group  
Holyoke Mutual Insurance Company in Salem  
International Property Catastrophe  
Reinsurance Company Ltd.

John Hancock Group  
Kemper Insurance Companies  
Keystone Insurance Companies  
LaSalle Re Ltd.  
Liberty Mutual Group  
Maine Mutual Fire Insurance Company  
Metropolitan Group  
Millers Mutual Insurance Company  
Montgomery Insurance Companies  
Motor Club of America Group  
Mutual Assurance Society of Virginia  
Mutual of Enumclaw Insurance Company  
Mutual of Omaha Group  
NAC Reinsurance Corporation  
National Grange Mutual Insurance Company  
Nationwide Insurance Enterprise  
Oregon Mutual Group  
Patrons Mutual Group of Connecticut  
PEMCO Insurance Companies  
PMA Reinsurance Corporation  
Prudential of America Group  
Redland Insurance Group  
Renaissance Reinsurance Ltd.  
Royal & SunAlliance U.S.A.  
SAFECO Insurance Companies  
Selective Insurance Group  
South Carolina Farm Bureau Mutual  
Insurance Company  
State Farm Group  
Swiss Reinsurance Group  
Tempest Reinsurance Company Ltd.  
TIG Holdings Group  
Toa-Re Insurance Company of America  
Union American Insurance Company  
Unisun Insurance Company  
US Facilities Insurance Group  
USAA Group  
Utica First Insurance Company  
Vesta Insurance Group  
X.L. Mid Ocean Reinsurance Company Ltd.  
Zurich Personal Insurance

*Effective 10/98*

# checklist

**H**ow well will your home resist damage during a category 3 or greater hurricane? Homes built before 1992 typically will need some reinforcement to withstand a major hurricane. But any existing home located in high wind regions should be inspected for wind-resistant construction if you are not certain. Here is a checklist that will help you decide whether your home needs strengthening. To answer some of these questions may require you to get up in your attic crawl space with a flashlight. You may feel more comfortable with an experienced inspector checking your home. Whatever choice you make, take some time to do this before the next storm strikes.

OBSERVATION	RECOMMENDATION	
<input type="checkbox"/> Roof covering leaks, is old or deteriorated	Replace with wind resistant roof covering.	Pg. 4
<input type="checkbox"/> Loose or missing roof covering components	Refasten or replace.	Pg. 6
<input type="checkbox"/> Deteriorated roof sheathing	Replace defective sheathing.	Pg. 5
<input type="checkbox"/> Inadequate or uncertain fastening of roof sheathing	Install wood adhesive.	Pg. 8
<input type="checkbox"/> Sheathing fasteners miss roof framing	Install wood adhesive.	Pg. 8
<input type="checkbox"/> Roof to wall connection: No or inadequate straps or hurricane clips	Install hurricane straps/clips as required.	Pg. 11
<input type="checkbox"/> No gable end wall bracing	Install according to recommendations.	Pg. 9
<input type="checkbox"/> Weak double-wide garage door	Replace with tested, hurricane resistant door or stiffen door with retrofit kit.	Pg. 12
<input type="checkbox"/> Unprotected patio door	Replace with tested, hurricane resistant doors and frames; install impact-tested shutters; or acquire temporary shutters and install mounting fixtures as required.	Pg. 15
<input type="checkbox"/> Weak entry door	Install heavy-duty hardware. Strengthen anchorage of frame to wall. Install hardware to support the top and bottom of the door.	Pg. 14
<input type="checkbox"/> Entry doors with large windows	Replace with impact-tested door frame. Acquire temporary shutters and install mounting fixtures as required.	Pg. 15
<input type="checkbox"/> Unprotected windows	Replace windows with tested, hurricane resistant windows, impact resistant shutters, or acquire temporary shutters and install mounting fixtures as required.	Pg. 15
<input type="checkbox"/> Inadequate or no wall to foundation connection	Install anchor bolts around perimeter walls.	Pg. 20



**175 Federal Street, Suite 500, Boston, MA 02110-2222**  
**(617) 292-2003 • Fax (617) 292-2022 • <http://www.ibhs.org/>**

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